Effect of water supply on the tree biodiversity - soil nutrient availability relationship in forests along the soil profile

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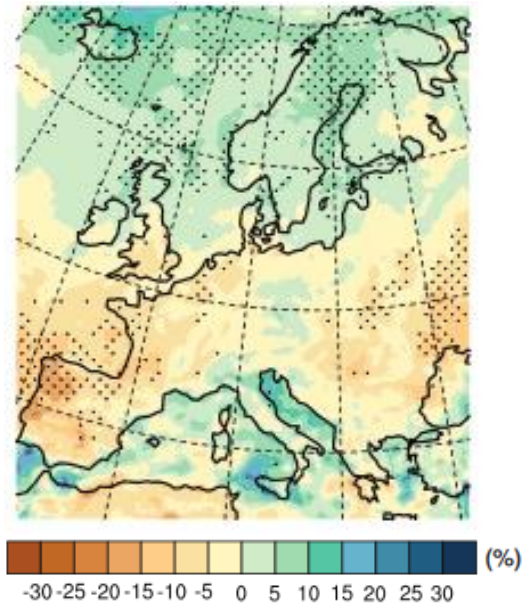
Forests

Major terrestrial ecosystem

Affected by global changes

Mean summer precipitation



Climate Model for 2016-2035
relative to 1986-2005

IPCC – The Physical Science Basis 2013

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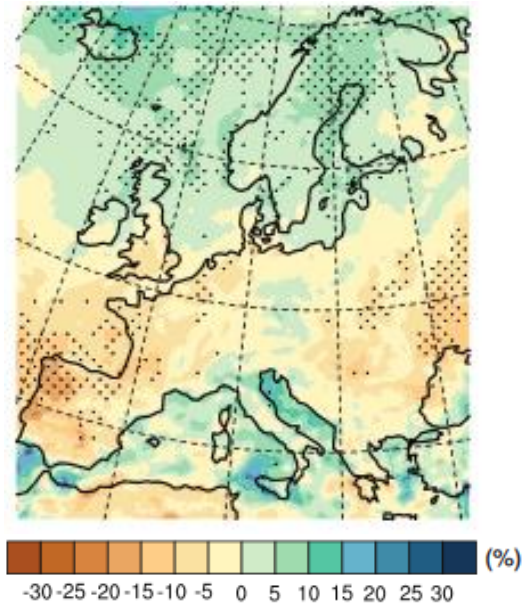

Climate Model for 2016-2035
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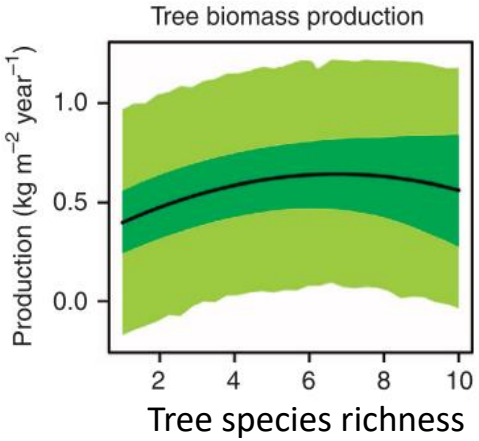
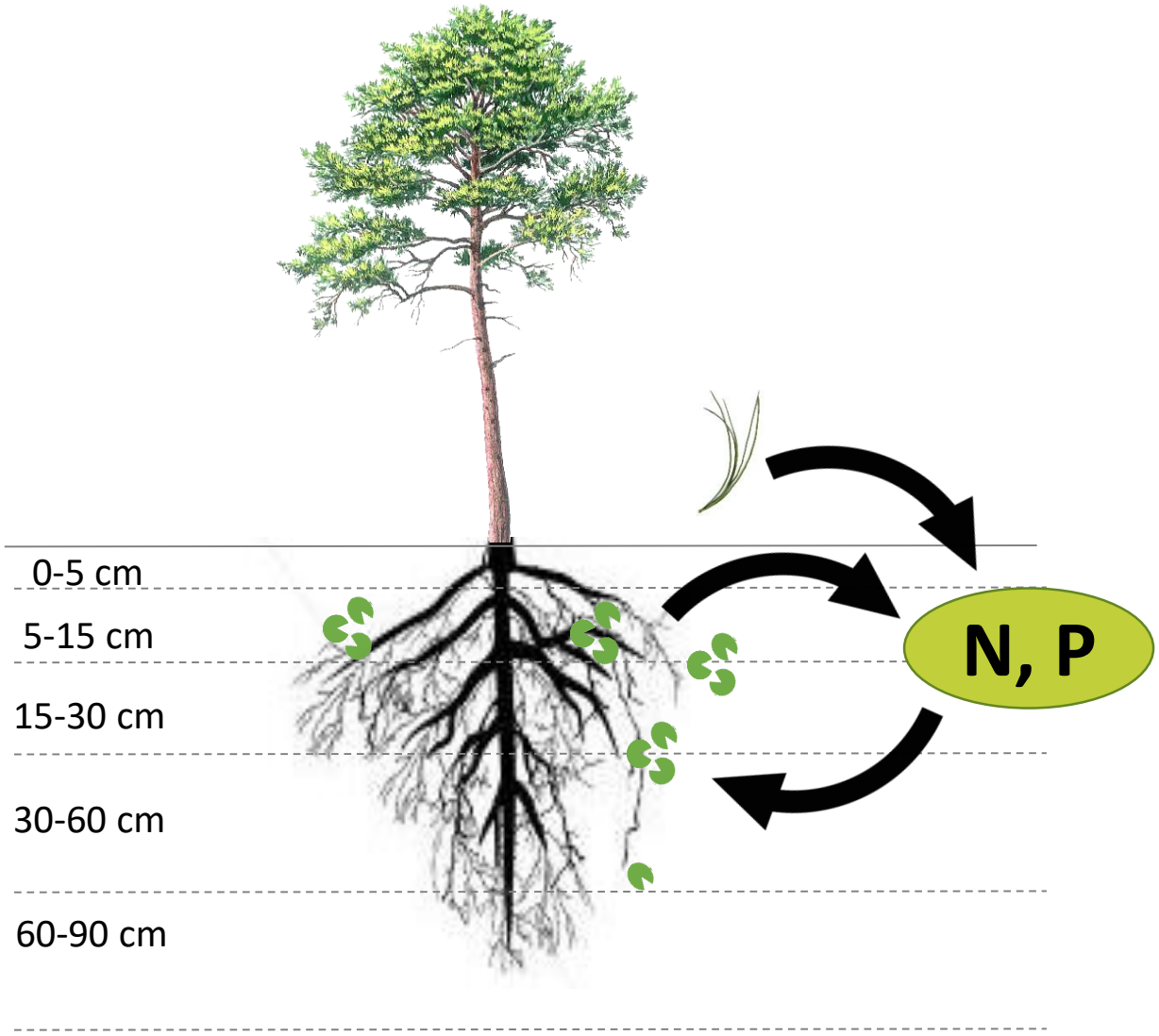
Mixed plantations may increase tree productivity



Gamfeldt et al. 2013

Soil functioning is still understudied

Nutrient cycling

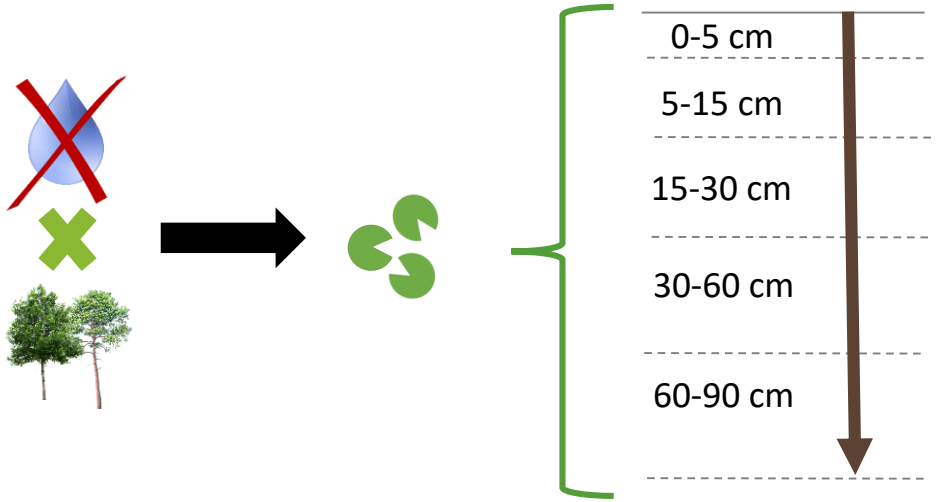


Soil enzyme activity as a proxy for microorganism activity and organic matter decomposition

Olander et al. 2000; Sinsabaugh et al. 2009.; Fatemi et al. 2016

Objective

How will **water** supply influence the effect of tree **diversity** on soil microorganism **activity** along the soil **profile**?



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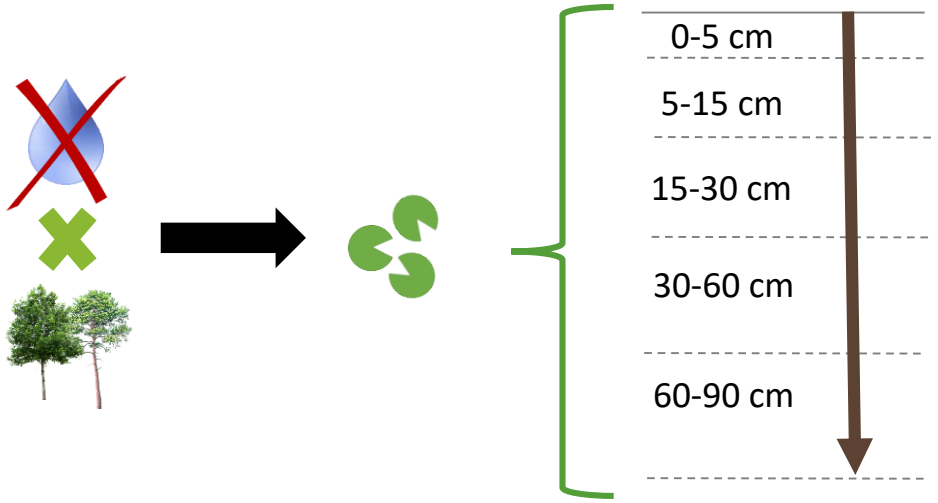
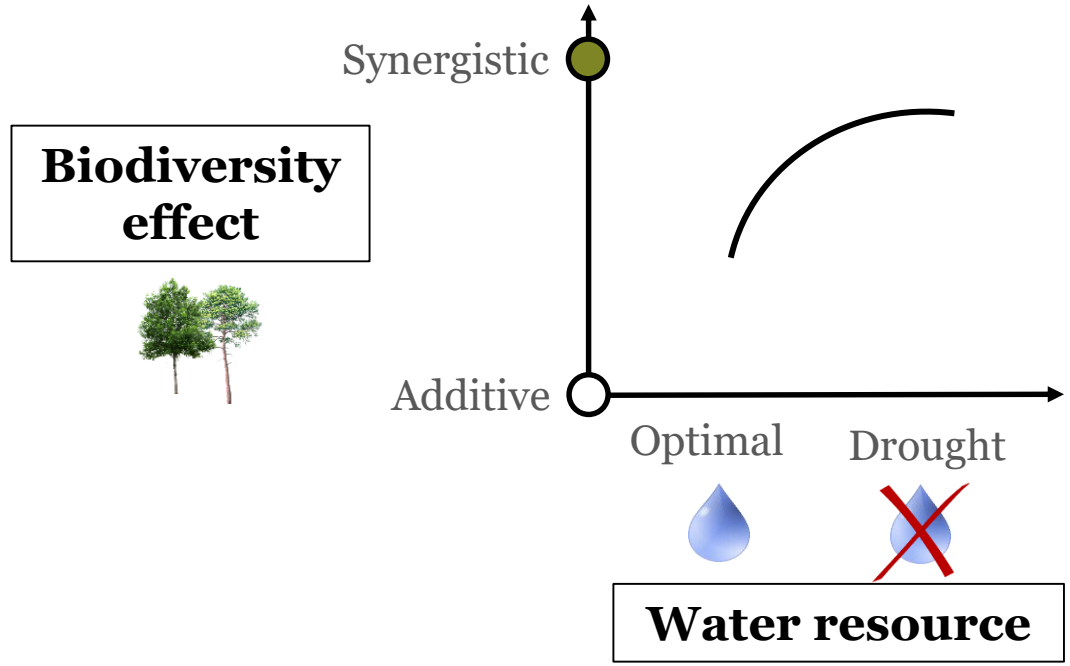
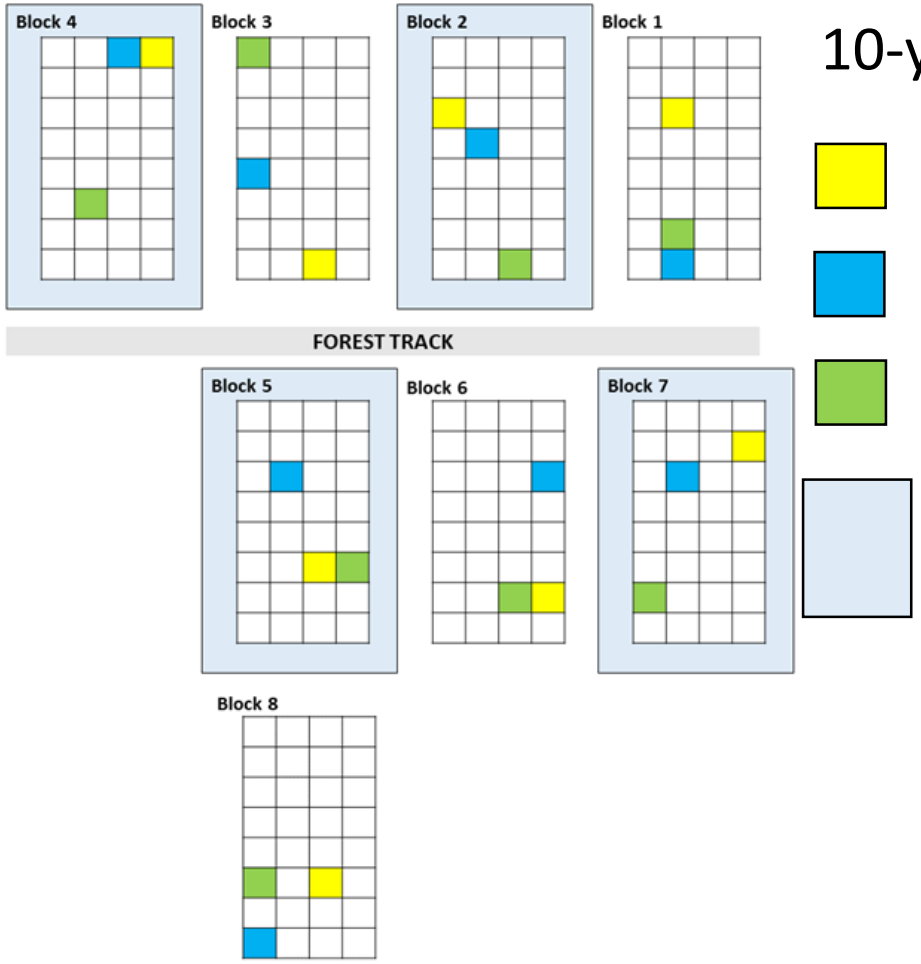


Hypothesis:



→ Root stratification and niche complementarity

Experimental site: ORPHEE



20m

20m

100 trees per plot

10-year-old platform in southwestern France (part of TreeDivNet)

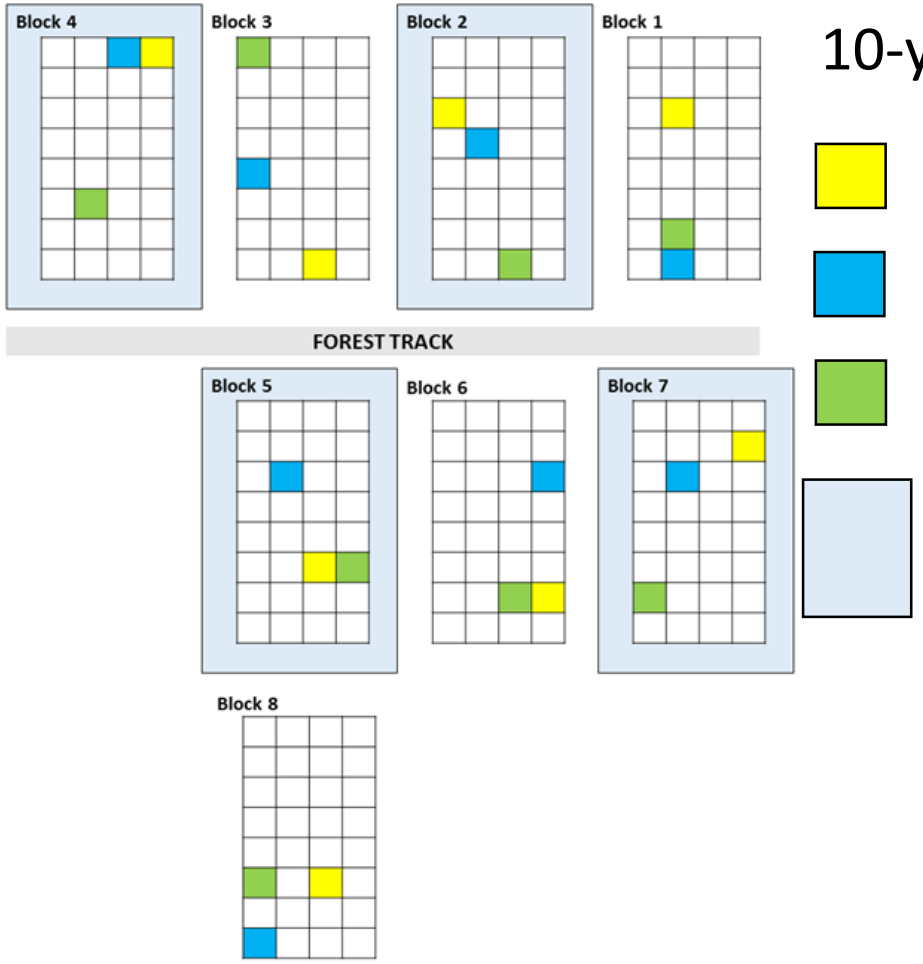
Silver birch (*Betula pendula*)

Martime pine (*Pinus pinaster*)

Mixed species plot: Birch + pine

Irrigated blocks vs.

Experimental site: ORPHEE



10-year-old platform in southwestern France (part of TreeDivNet)

- Silver birch (*Betula pendula*)
- Martime pine (*Pinus pinaster*)
- Mixed species plot: Birch + pine

Diversity

×

Irrigation

Irrigated blocks vs.

20m

20m

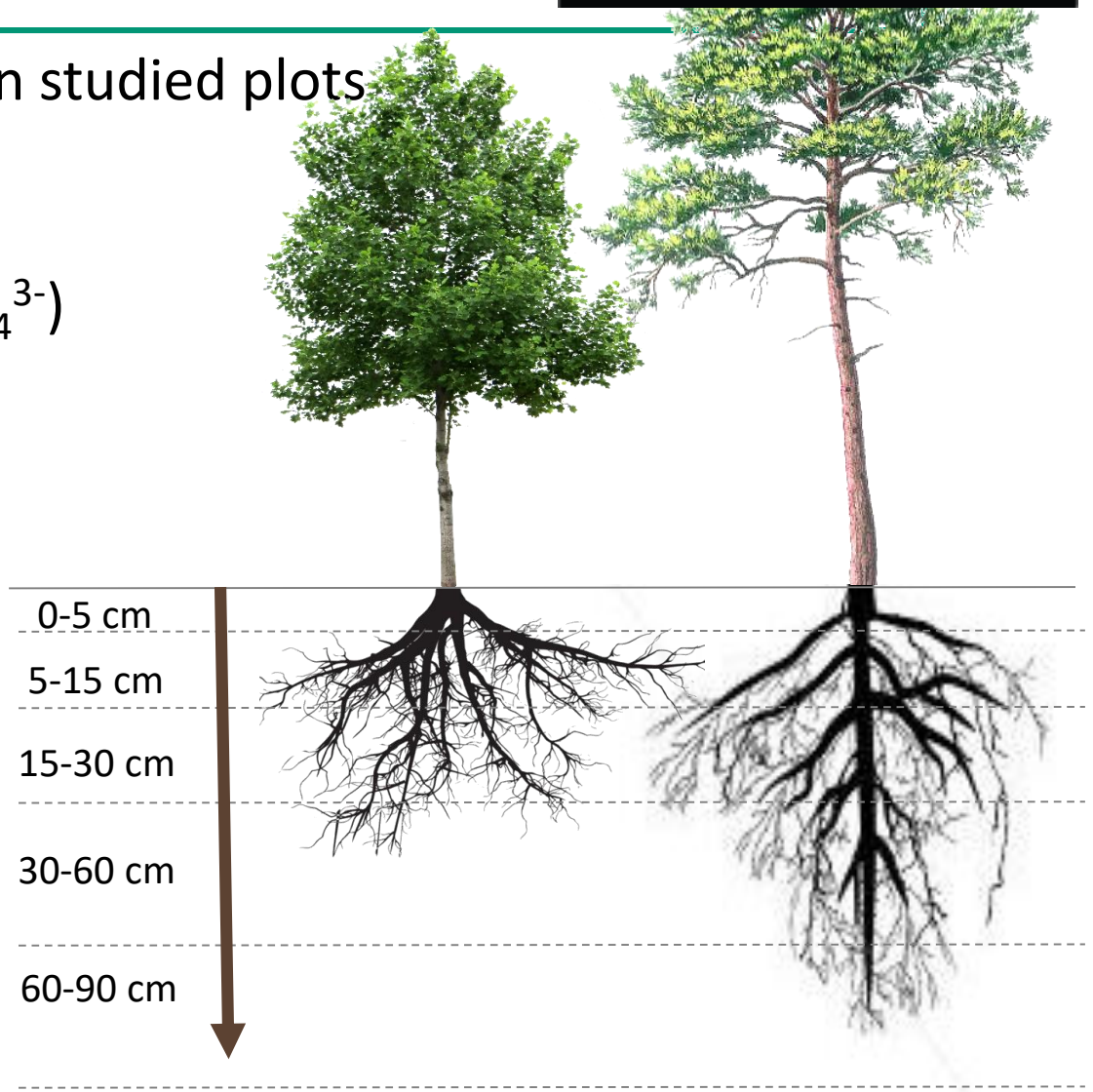
100 trees per plot

Methods

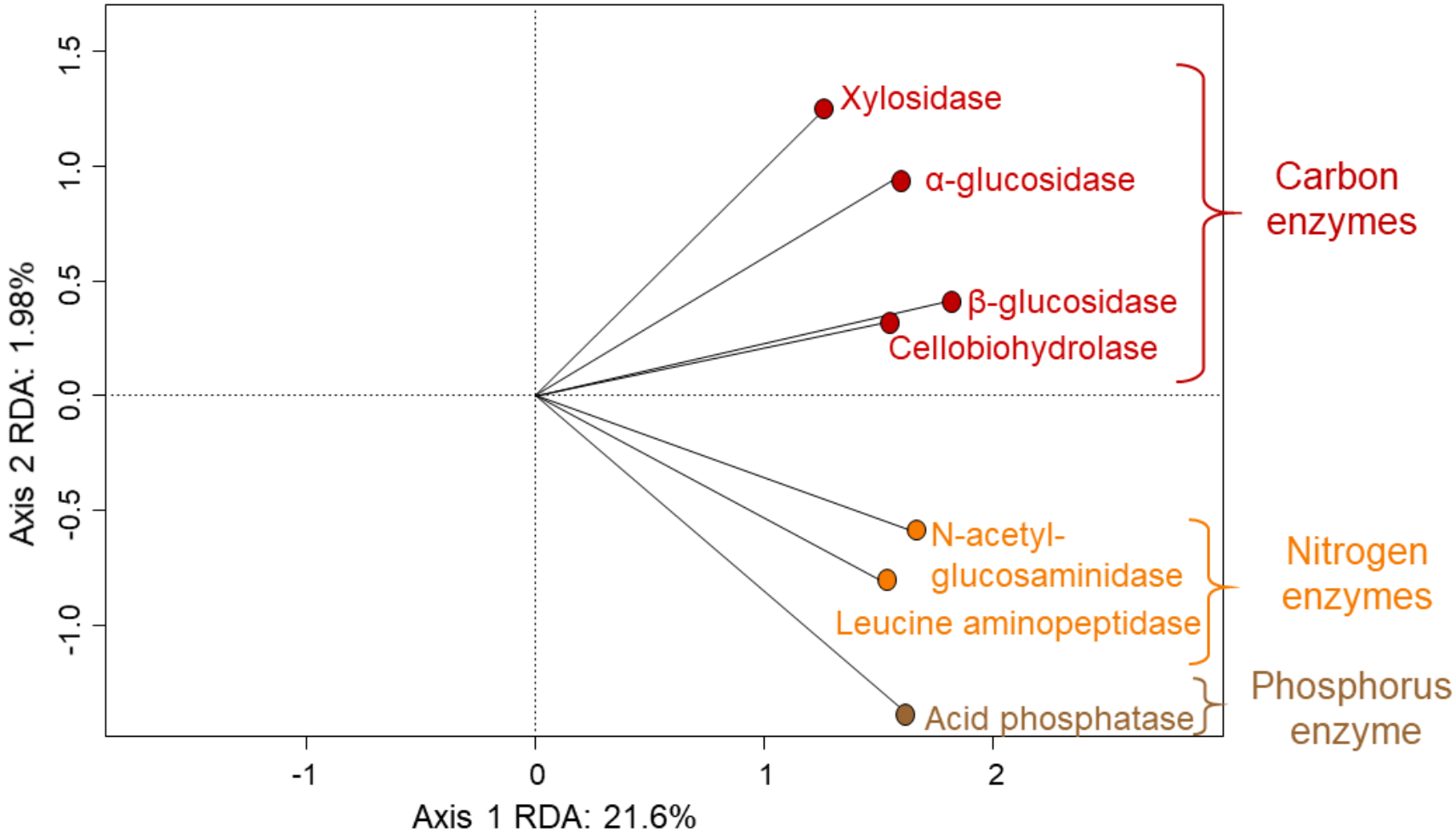
- Sampling in March 2018: 4 soil cores x 5 depths in studied plots

- Soil analyses:
  - Available N (NH_4^+ + NO_3^-) and available P (PO_4^{3-})
  - 7 soil hydrolytic enzyme activities
    - C-related
    - N-related
    - P enzyme
- Root data: biomass density and length

- Data analyses: 1. Redundancy analysis (RDA)
  2. Mixed models



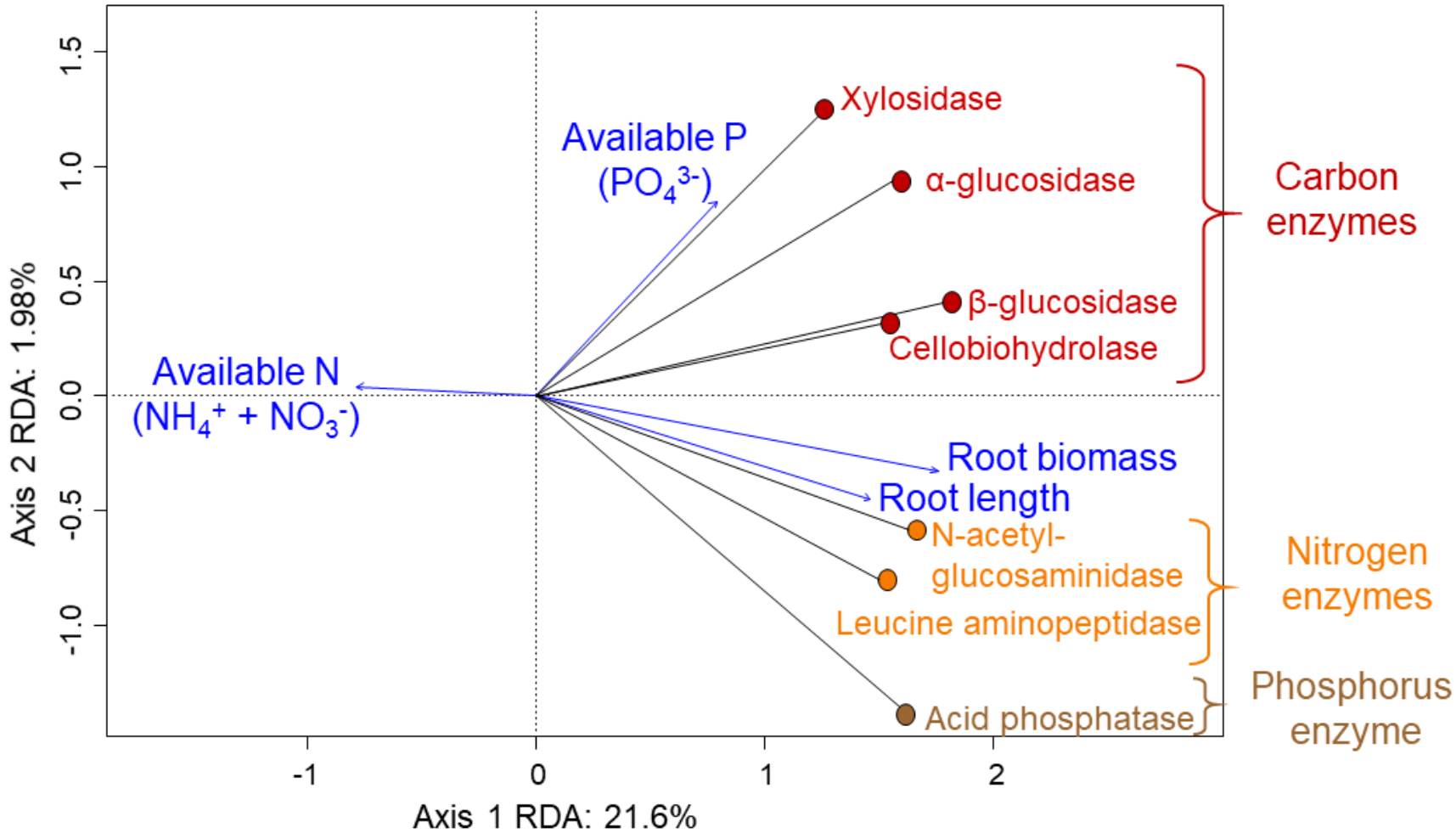
Results: an overview



Legend

Enzymes

Results: an overview



Legend

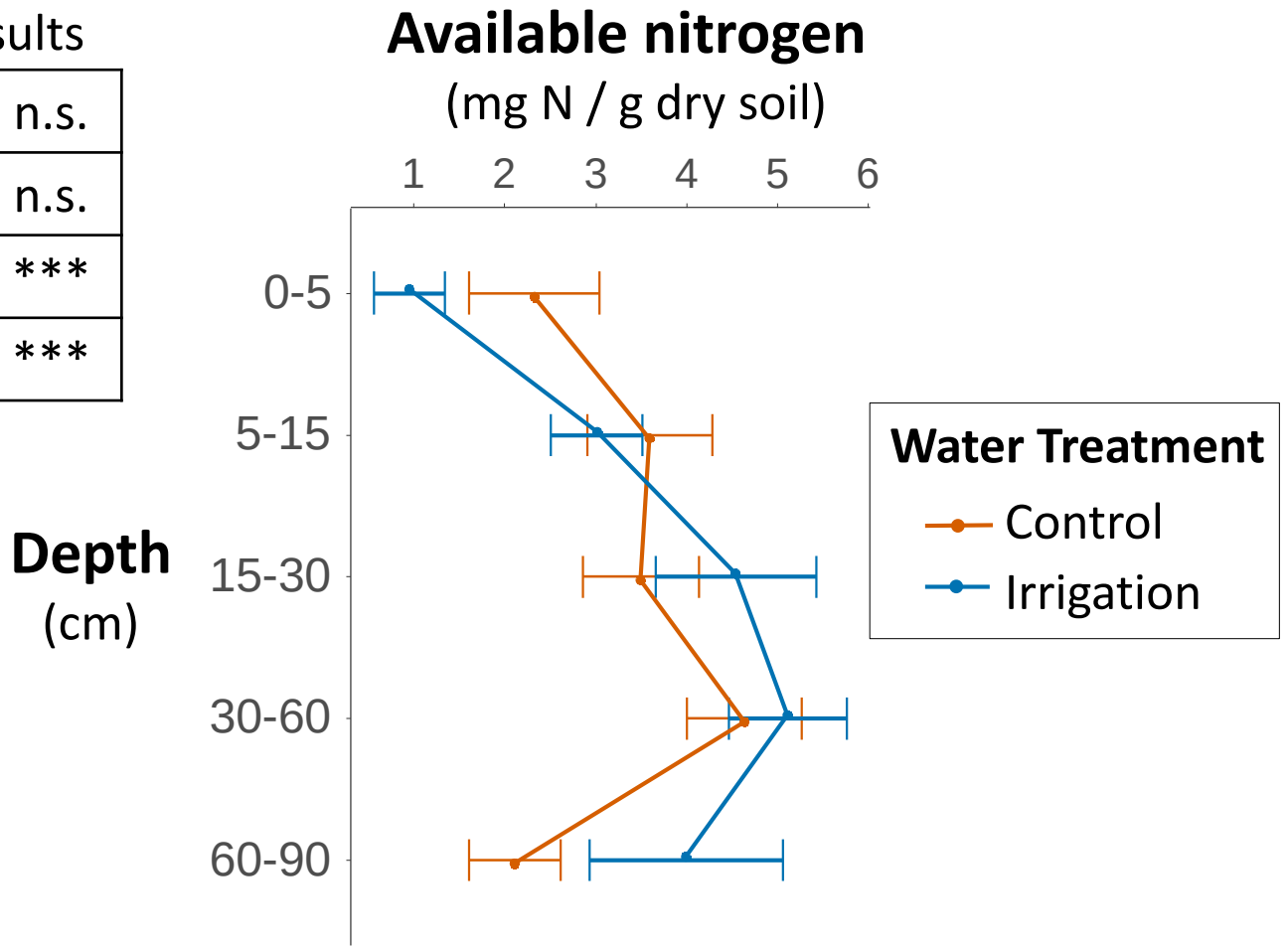
Enzymes

'Environmental variables'

Nitrogen availability

Statistical results

Diversity	n.s.
Irrigation	n.s.
Depth	***
x	***



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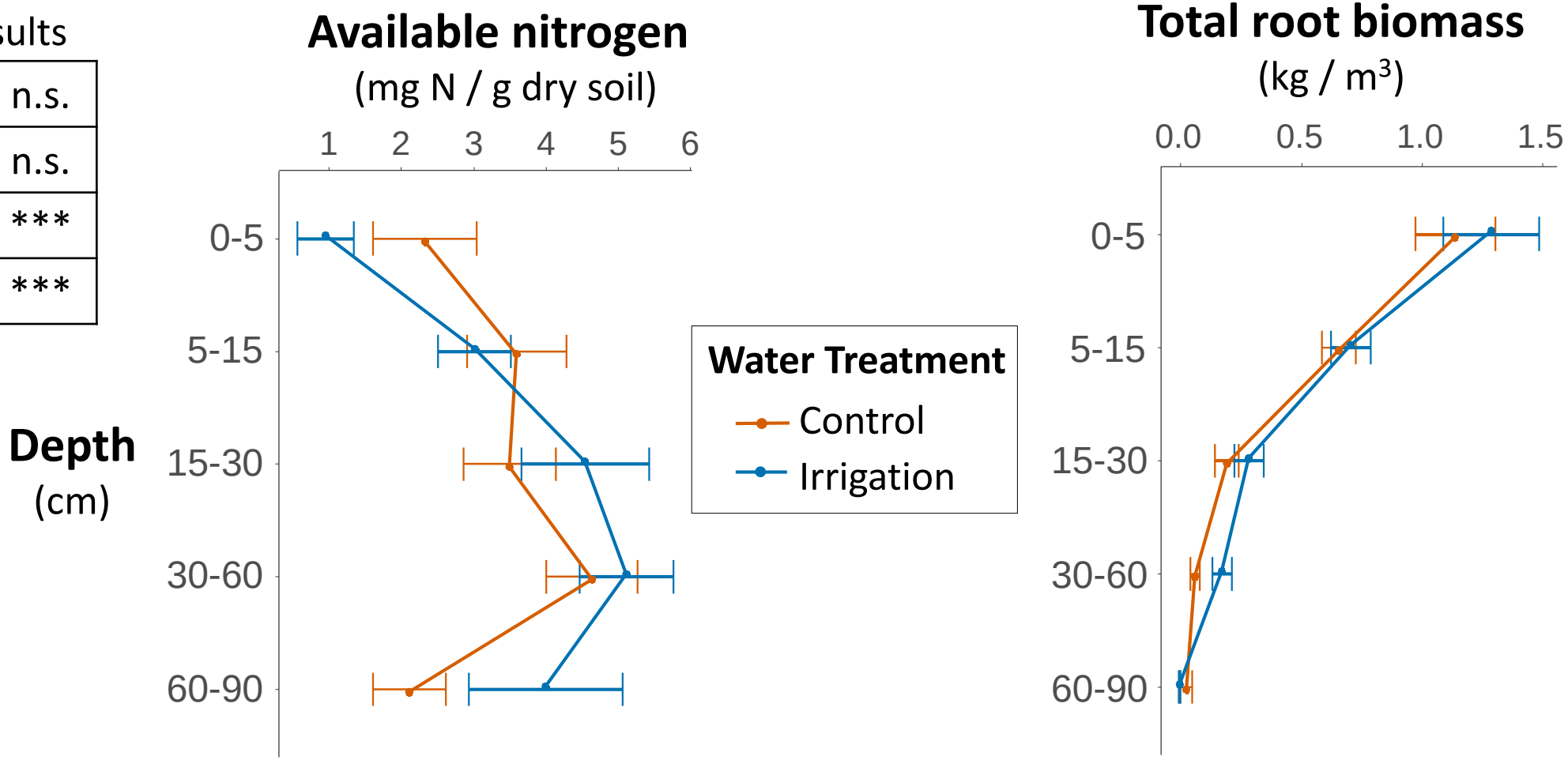
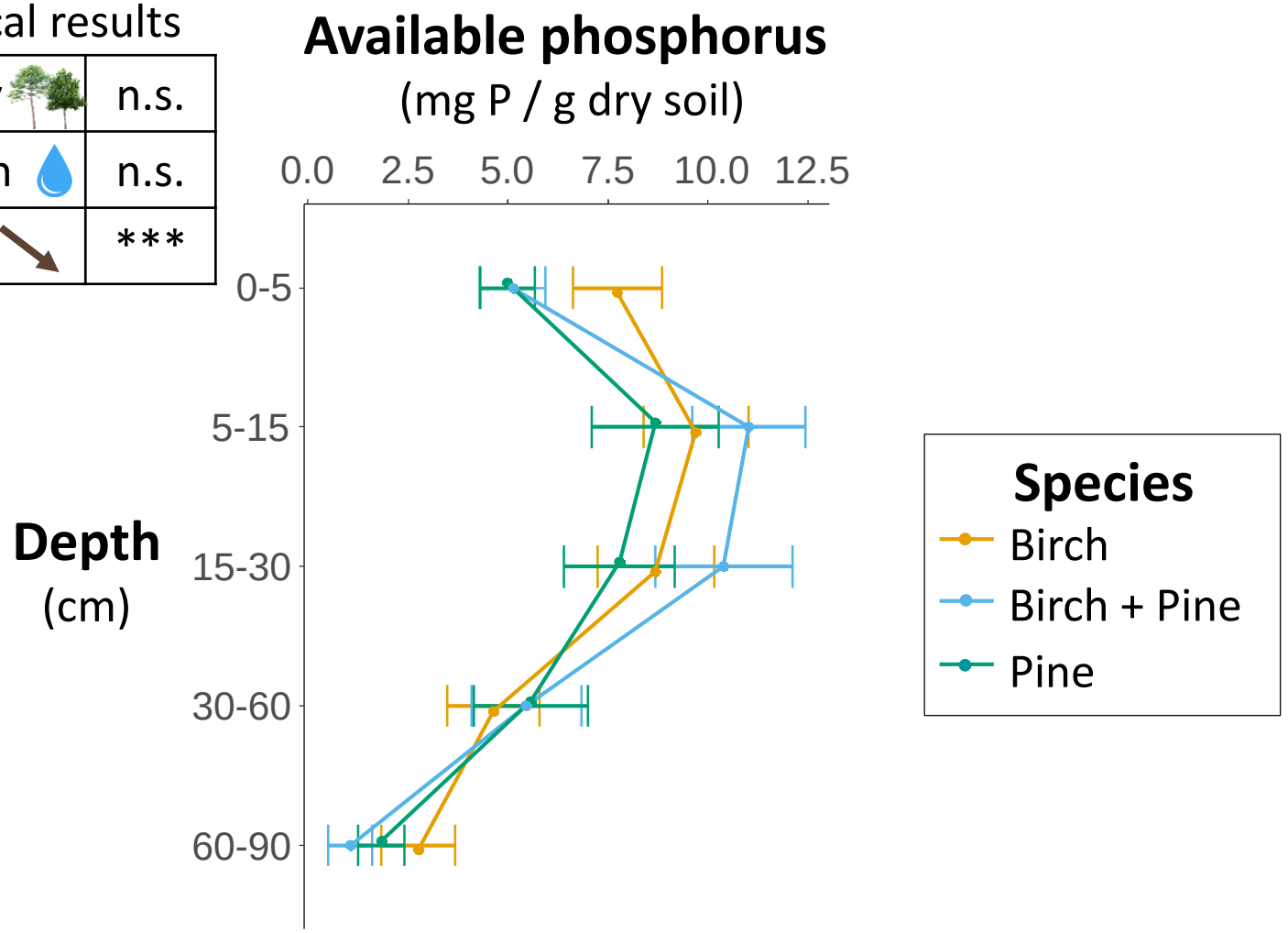


Phosphorus availability & C:P enzyme

Statistical results

Diversity	n.s.
Irrigation	n.s.
Depth	***

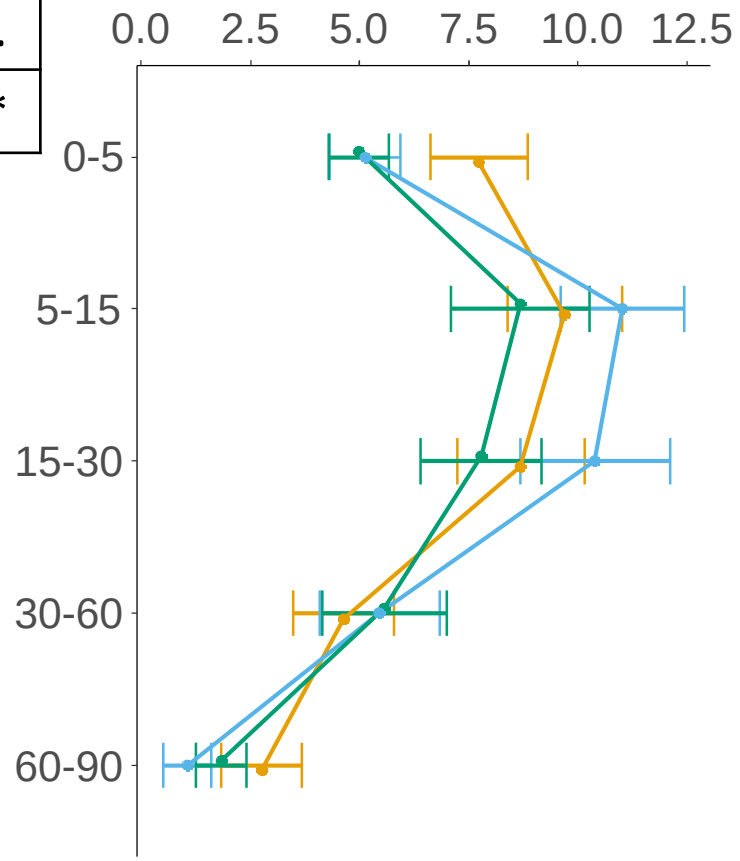


Phosphorus availability & C:P enzyme

Statistical results

Diversity	n.s.
Irrigation	n.s.
Depth	***

Available phosphorus
(mg P / g dry soil)

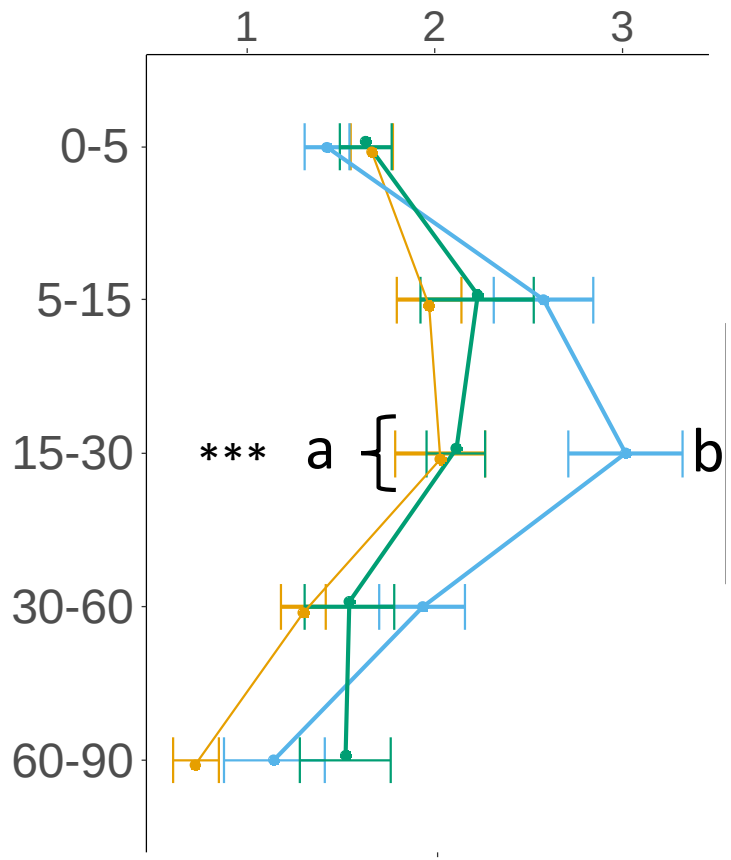


Statistical results

Diversity	n.s.
Irrigation	n.s.
Depth	***
x	**

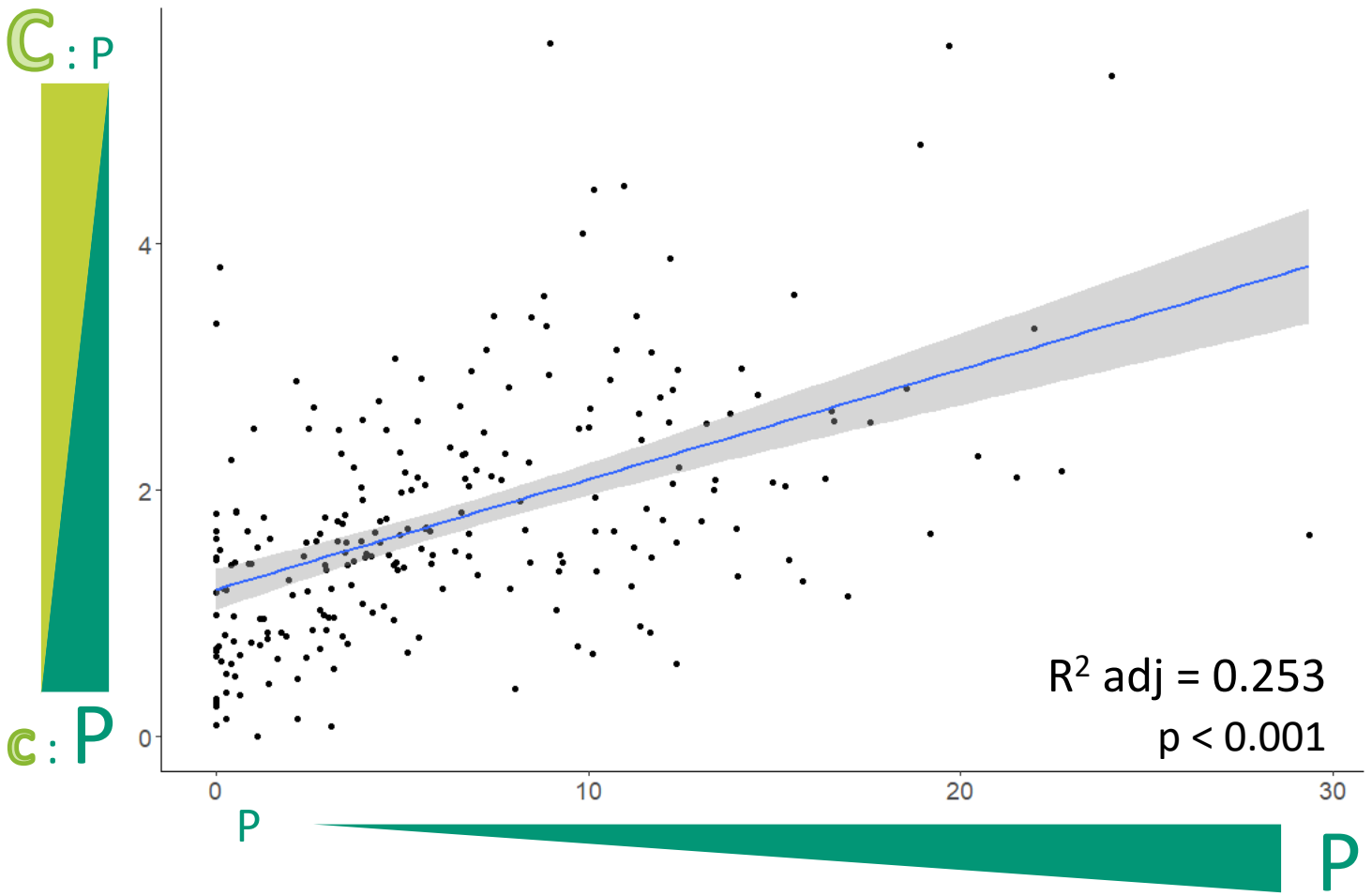
Species
- Birch
- Birch + Pine
- Pine

Ratio of C enzymes to P enzyme



An overall trend

Ratio of C enzymes to P enzyme



Available phosphorus
(mg P / g dry soil)

Conclusions

Top soils: - N

Deeper soils: + N

Mid soils: + P?
+ C:P enzyme

x

No effect

Different responses along the soil profile

Upcoming studies on belowground processes → temporal complementarity

Thank you.




Funding:

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